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REPORT NO. 10

FOREST - RANGE ENVIRONMENTAL STUDY

A Scientific Tool for Determining National Range Grazing Policy

U.S. DEPARTMENT OF AGRICULTURE • FOREST SERVICE • MAY 1973

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FOREST-RANGE ENVIRONMENTAL STUDY

Introduction

With the recognition that land and other natural resources are finite and that quality of land management and cost must be considered along with quantity of products, a new sophistication in land management has been developing in the last few years. This kind of management requires full consideration of all resources and all uses including livestock grazing on forests and rangelands.

To get information needed for defining the present and future role of livestock grazing in the new environmental context, the Forest Service, U.S. Department of Agriculture, with the help of a number of other agencies and the University of Nebraska, undertook a national study of all the forests and rangelands in the 48 contiguous States.

The emphasis of the study was to define land-management policy alternatives that would contribute productively to meeting society's needs while enhancing quality of the natural environment at the smallest cost.

The study, designated as Forest-Range Environmental Study (FRES), provides an up-to-date, detailed picture of the current and future production of resources and the role of grazing on all forest lands and rangelands. For purposes of the study, all natural ecosystems that produce or can produce forage, including forest areas as well as areas of range with grass or shrubby vegetation, were called "forest-range," and all were studied.

The Forest-Range Environmental Study expanded the scope of two earlier major range studies. The first involved the forage resources and grazing practices for only western ranges. The second was limited to public grazing lands of the Nation.

Besides assembling information about all of the Nation's forest and range forage resources, the study developed technology for evaluation of the information in a way that will provide a base for the planning needs of the Forest Service and other land managers who wish to use it.

From this information base and these analytical systems, alternatives have been prepared in the study for consideration in setting future direction of Forest Service programs in range resource management, both for the lands the agency manages directly and the lands that might benefit from technical assistance. The alternatives were tested with the aim of finding the greatest efficiencies in Forest Service range programs within the larger context of national supply and demand, and within the bounds of Forest Service objectives.

Data and advice were provided by the Bureau of Land Management, National Park Service, Fish and Wildlife Service and Bureau of Indian Affairs of the Department of the Interior, and the Soil Conservation Service, Agricultural Stabilization and Conservation Service, and the Cooperative States Research Service of the Department of Agriculture. The Economic Research Service, USDA, cooperated in developing the computer system, assisted by the University of Nebraska.

In developing the system of inventory and evaluation, as well as possible alternatives, personnel from all major Forest Service units and the national headquarters staff participated. Professionals from scientific and administrative disciplines represented forestry, range, ecology, watershed, hydrology, soils, economics, recreation, landscape architecture and computer sciences.

General Conclusions

Livestock grazing is one of the most extensive uses of land in the United States and the Nation's forests and ranges are important sources of forage. An increasing supply of forest and range forage will be needed in the remaining years of this century. It will be an important food source for cattle and sheep to fulfill the meat and wool requirements for a growing population. It is comparatively cheap as a livestock food source, competitive with other forage, and stockmen are unlikely to abandon it for more expensive pastures.

At the same time, public demands on the same lands for other uses and benefits will grow also. These demands and the demands for a high level of quality in environment will be particularly strong on public lands.

The study indicates, however, that increased production of grazing from the Nation's forest-range environment can be achieved on a national basis without reduction in environmental quality. Efficiency in allocation of land to resource use for achievement of these ends can be assisted through the analytical system developed in the study.

The Forest-Range Situation in 1970

The area of forest and range ecosystems in the continental United States (excluding Alaska and Hawaii) is 1.2 billion acres, or 63 percent of their total land area. Every State has significant amounts of forest-range, with the highest regional acreage--83 percent--in the eleven Western States. However, forest-range comprises about three-fifths of the Southeast, one-half of the Plains, and two-fifths of the Northeast as well. Interestingly, one-fourth of the important farm-belt State of Ohio is classified as forest-range.

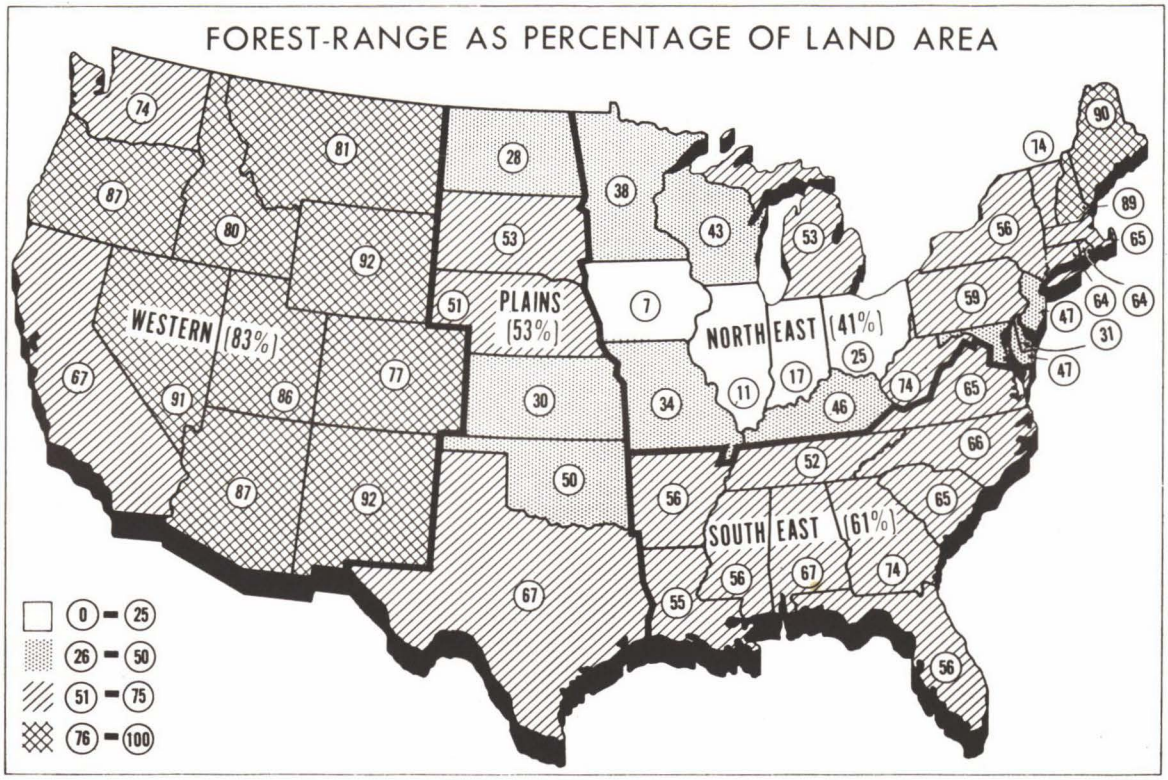

Figure 1

The Forest Service maintains jurisdiction over 14 percent of this land (166 million acres). Other Federal land totals 207 million acres (17 percent) and non-Federal lands total 829 million acres (69 percent).

The eleven western States dominate in total area, with 622 million acres of forest-range. The Great Plains has 214 million acres; the Southeast, 184 million; and Northeast, 182 million. There is more than twice as much forest and range as the combined acreage of cropland, urban areas, rural highways, railroads, airports, farmsteads, and farm roads and lanes, and twelve times as much as all improved private pasture.

FOREST-RANGE, IMPROVED PRIVATE PASTURE, AND OTHER LAND BY GEOGRAPHIC REGION, 1970

(Million Acres)
(Totals have been adjusted to balance)

Geographic region	Forest-range environment	Improved private pasture	Other land 1/	Total land area
Western	622	9	122	753
Plains	214	24	169	407
Northeast	182	40	219	441
Southeast	184	28	88	300
Total	1,202	101	598	1,901

1/ Urban areas, rural highways, railroads, airports, croplands farmsteads, farm roads and lanes.

The categories of forest-range rank in acreage from the 173 million acres of Plains grasslands to the one million acres of redwood forest lands. More than half the total is in six categories--Plains grasslands, oak-hickory, sagebrush, desert shrub, mountain grasslands, and loblolly-shortleaf pine. Although of small acreage, alpine areas have important water-yielding and scenic values as well as some livestock grazing.

About two-thirds of Forest Service-administered forest-range land is forested, and most of it is concentrated in the West. Other Federal ownerships are concentrated in the West also, but most of the non-Federal land is in the Great Plains and Eastern Forest areas. More than 95 percent of the Plains and 92 percent of the Eastern Forest are in private ownership.

Of the 1.2 billion acres of forest-range lands 835 million (69 percent) were grazed by livestock in 1970. They produced enough forage for 213 million animal-unit-months (an animal-unit-month is a measure of the forage needed to sustain one mature cow for one month), and generated 196 million man-hours of work in direct employment and $1.7 billion in animal production value. Sixty-nine percent of the forest-range is non-Federally owned and this produces 85 percent of the grazing. Of the remaining 15 percent, the National Forest System produces five percent and the other Federal lands ten percent. (See Figure 2)

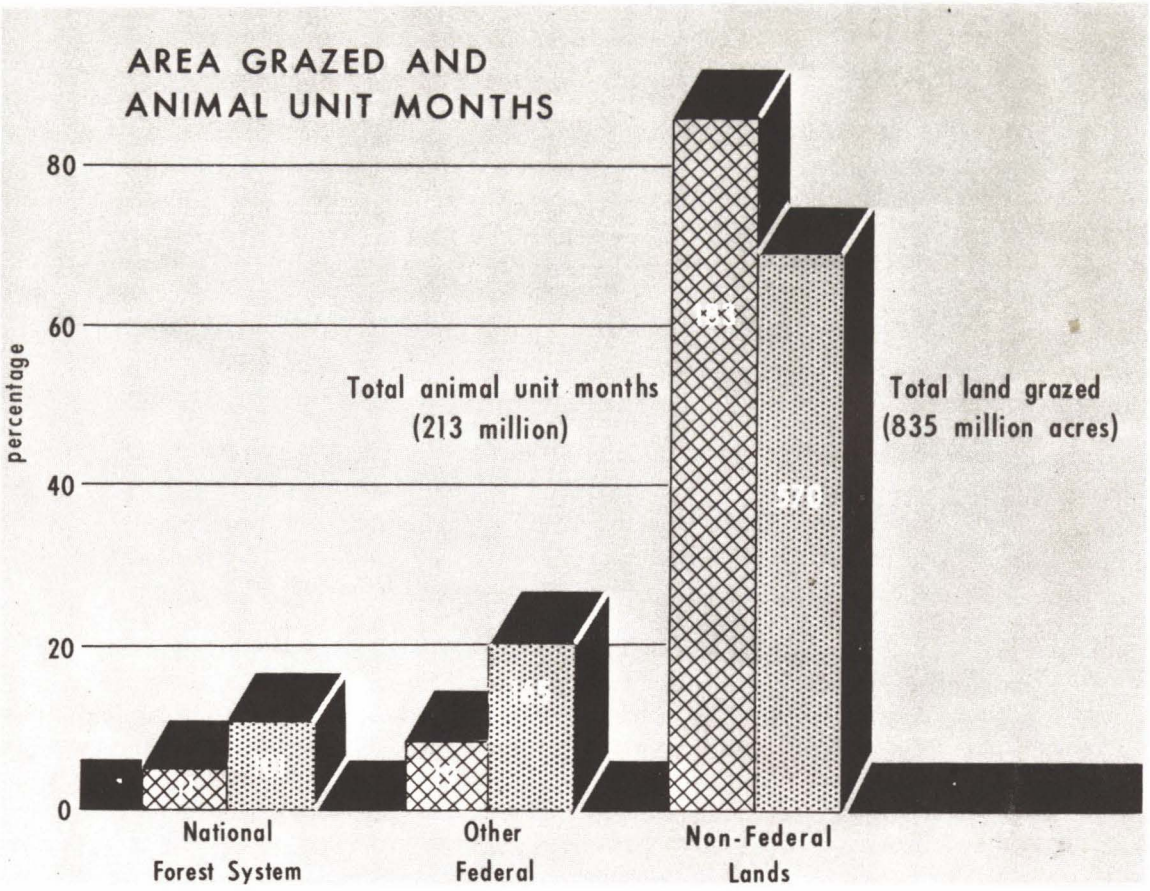

Figure 2

Overall, between 20 and 39 percent of the forest-range by ownership was not grazed in 1970 (figure 3). Of the different levels or intensities of grazing, "some livestock" and "extensive management" were the most common and were being applied on about one-half to two-thirds of the land.

("Some livestock" refers to a management level in which livestock is grazed with only enough investment to assure maintenance of the environment. "Extensive management" involves such means as fencing and water developments as needed to obtain livestock distribution and plant use to maintain plant vigor and density.)

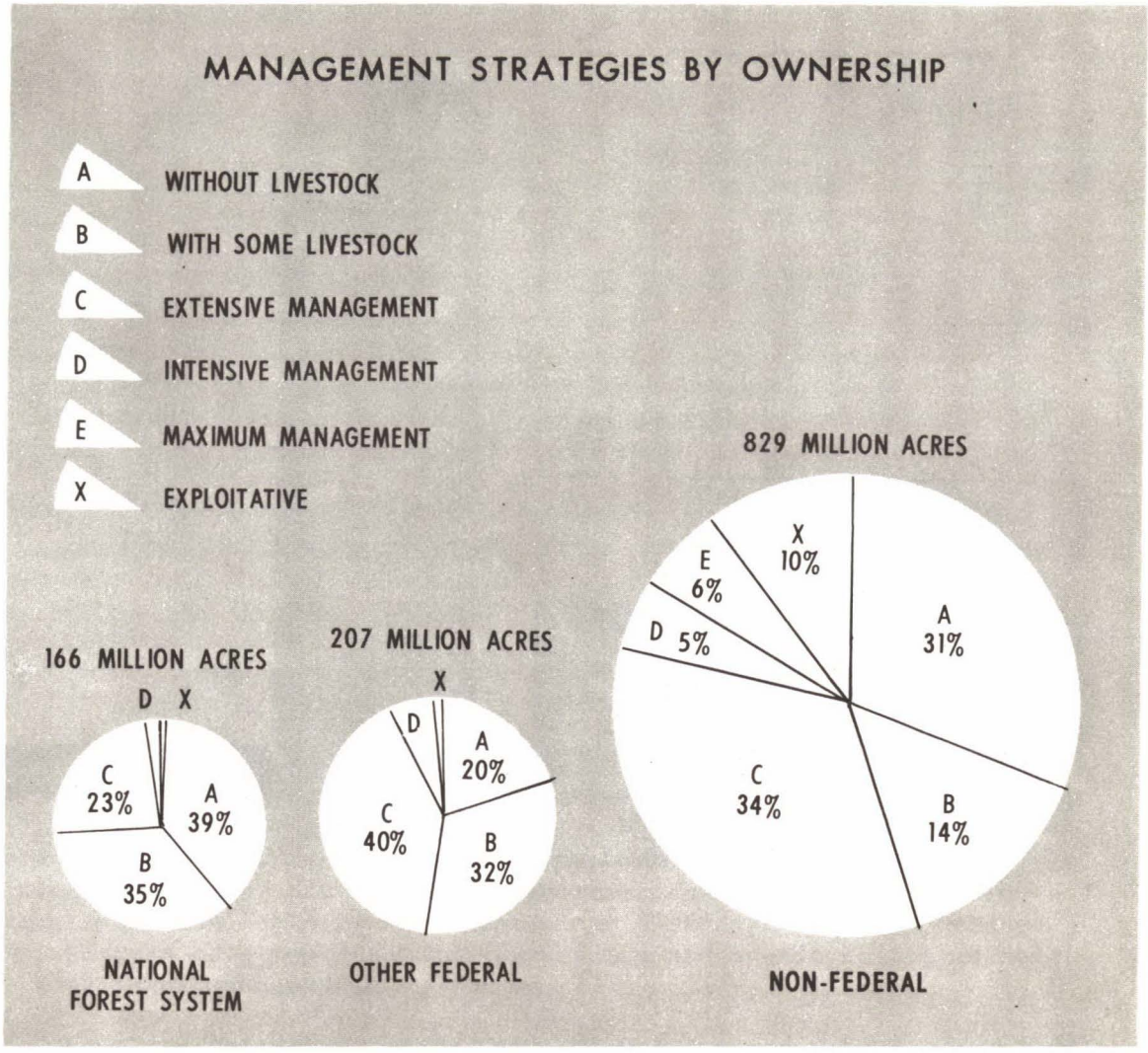

Figure 3

Fifty-eight million acres were managed intensively, a level at which use of all available technology for range and livestock management is considered. Considerable exploitative grazing was found, with most of it (72 million acres) occurring in the Eastern Forest area. Exploitative grazing was defined as grazing in a manner that depletes the soil or vegetation and violates the principle of sustained yield.

Almost half of the 213 million animal units produced on all forest-range resulted from "extensive management" of the land. Only 26 million were produced under intensive management, and 18 million under exploitative conditions.

Average production from all forest-range lands grazed was about four acres per animal-unit-month, or about 20 acres per animal unit per five-month grazing season. However, the production varied from nine acres per animal-unit-month (AUM) for Federal lands to three acres on non-Federal lands.

The forest-range lands were highly productive of other products as well. For example, an average acre of these grazing lands produced about two-thirds of an acre-foot of water yearly (a total of 780 million acre-feet for all acreage.) Some 90 percent of it was high quality. These lands also produced 20 1/2 billion cubic feet of new wood growth annually and supported most of the Nation's wildlife.

Future Demands From the Forest-Range Environment

This information on productivity of all resources had to be related to man's needs. Thus, studies of demand had to be made. Emphasis in the analysis of expected demand was primarily on livestock grazing and its production targets. But other demands, including those for economic goods and amenity values, were taken into consideration to suggest environmental or economic consequences which would occur with application of different management policies. This was necessary because of the public's increasing concerns about the environment.

These studies suggested the demand for grazing will continue to increase, as well as the demand for nearly all of the other possible products of the forest-range environment.

The outlook for demands was developed within the context of commitments of the Nation to good care of basic resources, maintenance or enhancement of environmental quality, production of goods and services and fulfillment of social demands.

To reach conclusions on demands, the obvious first considerations were population growth, economic growth and expected need for meat and other foodstuffs in the years ahead.

A conservative estimate by the Bureau of Census showed that population of the United States will possibly rise to 281 million by the year 2000, about 1.3 times above the 1970 level. Personal income is expected to grow fourfold.

With both population and income growing at these rates, expanded markets for farm products are expected. Rising incomes are expected to lead to increasing shifts to foods of higher value, such as meat. Preference for beef is expected to rise strongly.

As a sign of this, beef production increased 41 percent between 1960 and 1968. This increase, along with a doubling of beef imports, provided beef for an 11 percent increase in population.

The per capita consumption of beef and veal in the 1947-49 period was 75.3 pounds. By 1963-65, it had risen to 103 pounds (it was 117 pounds in 1972) and by the year 2000 consumption is expected to rise to 135 pounds per person. (Figure 4)

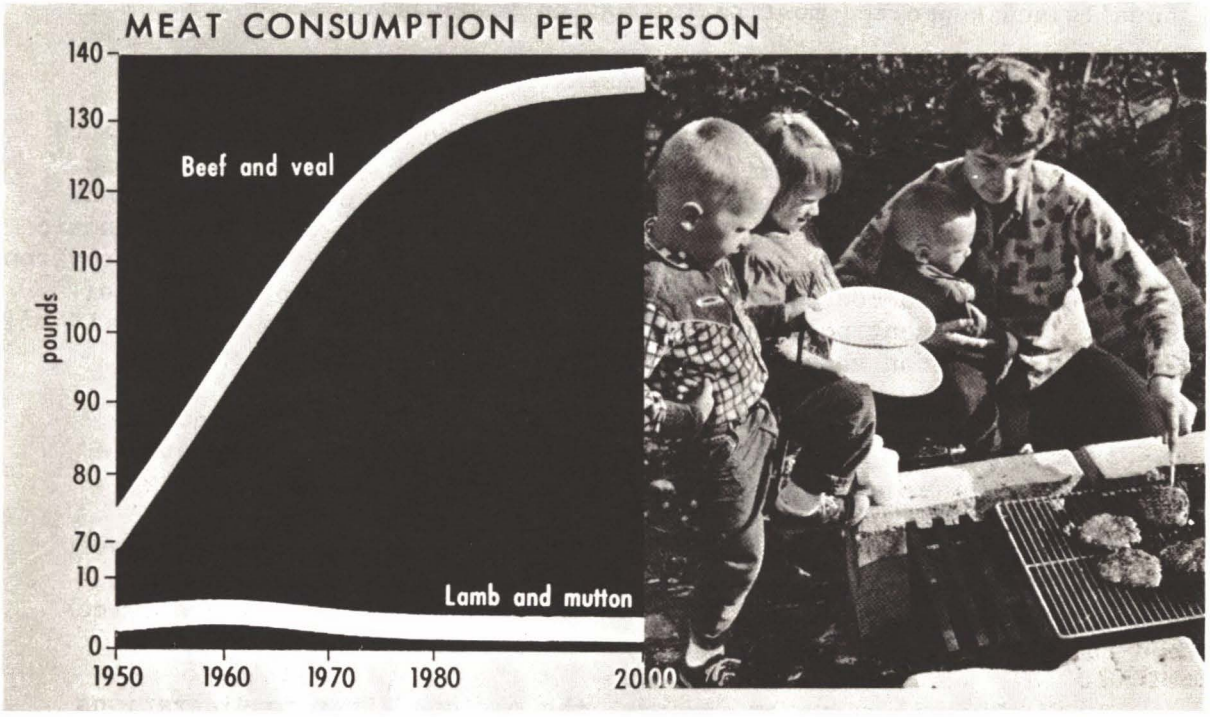

Figure 4

Wool consumption per capita is expected to dip slightly by year 2000, but the total will still rise from 387 million pounds in 1965 to 554 million pounds by the year 2000.

Further study of demand led to the conclusion that while need for all grazing is going to increase as total food energy needs for livestock increase, the share to be provided by improved pasture and all range sources will decrease. In addition, it was assumed there would be no change in the relative shares of grazing to be provided by improved pastures and forest-range.

Thus, even considering imports of meat and wool, as well as non-range forage and feeding systems, demands are expected to be great enough to require 320 million animal-unit-months of forage production from the forest and range grazing lands by the end of the century.

This conclusion was reached with the further assumption that range costs would not increase relative to other livestock feed sources. Historically, the most consistent feature of forest-range has been its use as a low-cost feed source.

Putting the Inventory and Analysis System Together

The Study required knowing the quantity and quality of resources produced nationwide on the forest-range in 1970 and the quantity and quality of these resources that would result under different kinds of range management. Since management efficiency was an objective of the Study, also needed was how much it cost to attain each level of management.

To answer these questions, the Study teams first determined the 1970 production or quality for each of 22 resource outputs from each of 956 resource units or land areas into which all forest-range was divided.

To obtain these units, the 1.2 billion acres of forest-range within the 1.9 billion acres in the 48 States were categorized into 34 ecosystems, based on potential vegetation. These units were also separated by how much vegetation or wood they could grow and whether they were in good, fair, or poor condition. Number and size of trees also were used as part of the separation process on forested areas. After a fourth breakdown into three different ownerships (National Forest System, Other Federal and Non-Federal), 956 study units called "resource units" resulted.

Six packages of range management practices were then designed for each of those same units. These packages contained enough fencing, stockwater development, seeding, etc., to manage the range at specific intensities of grazing.

Each package involved a "strategy" of management---a goal. These varied in intensity of grazing as follows:

A--No livestock grazing at all; B--Some livestock grazing; C--Extensive management of environment and livestock; D--Intensive management of environment and livestock; and E--Environmental management, with livestock production predominant. A sixth intensity, exploitation by grazing, though not a desirable management goal, was included because it was known to exist.

Next, the teams estimated the grazing, environmental, social and esthetic outputs---all 22 of them--expected from each unit under each of the six levels (or "strategies") of management.

In addition to forage and grazing, the Study measured wood growth, water yield, and sedimentation, as well as several other measurable resources. For those which could not be given unit measurements, qualitative ratings were established. These covered such features as soil stability, air quality, scenery and solitude, habitat quality for wildlife, recreation, and cultural heritage factors.

With this information at hand, the stage was then set for determining the most economical way for reaching specified production levels of grazing. But the system as designed also allowed the workers to set up limitations that favored environmental quality and production.

Finally, through use of an analytical system called Forest-Range Environmental Production Analytical System (FREPAS), specially developed for the Study, the least-cost programs of range management for achieving required levels of grazing production and selected levels of associated products were determined. FREPAS, while seeking the least costly alternative, can be constrained to favor environmental values, wood growth, water yield, etc.

Many alternatives were designed and evaluated in testing the system. Each alternative had its own formula that told how much grazing was to be produced and to what degree the different factors of the environment were to be protected. The built-in constraining capability of FREPAS to limit grazing to levels and practices that protect or enhance the environment was employed in many of the alternatives. Alternatives were compared against one another for costs of producing grazing and their expected impact upon the numerous environmental outputs.

Spectrum of Alternatives

The Forest-Range resource situation existing in 1970 was the starting point for evaluating more than 25 simulated grazing management situations.

These simulations, as previously noted, were created for the most part by combinations of range management practices under five different "strategies" or management intensities. At one end of this five-stage spectrum was exclusion of livestock from the forest-range land altogether and feeding it on improved pasture, cropland or in feedlots. At the other extreme was management under which livestock production was the predominant consideration, unconstrained by multiple use. A sixth intensity of use--exploitation--was identified and tested because of its existence on some lands today. But it was not considered acceptable for any future management encompassed by the study.

Present Policies, Practices

The initial step in examination of alternatives was to produce a picture of the management practices as they exist today and the theoretical direction they could take in the future if unchanged.

Managers of much of the Nation's forest and range lands recognize the need for environmental considerations, along with the production of grazing. And they have conducted many beneficial range programs as a result. Furthermore, these operators are aware of the opportunities for increasing production of grazing through range development and management.

However, the examination of present policies and practices among all ownerships indicate that adjustments will be necessary both to achieve the estimated needs in animal-unit-month production and the estimated environmental quality requirements by the end of the century.

In addition, an unchanged projection of present practices and policies could result in investment costs per animal-unit-month somewhat higher than they are today.

Single 'Strategy'

Single strategy management applications (ranging from "no livestock" to "maximize livestock") were also tested. "Single strategy" means that each of the five major kinds of management was applied by simulation in turn to all lands of the forest-range. As expected, none of these alternatives exhibited sufficient favorable factors to justify acceptance.

In general, the single strategy approach promised results either in more commodity output (grazing) than demanded, and less of the environmental values required, or vice versa. This led to the conclusion that a combination of management "strategies" fitted to the productivity and management investment costs of each resource unit will most likely achieve the many goals to be required.

Mixed Strategy Analysis

Mixed strategy analysis is where the production capability and cost under each level of management, i.e., management strategy, is brought fully into play. With this approach, national goals for producing animal-unit-months of grazing are established, together with limitations protecting the environment. Then the system assigns the level of management for each of the 956 resource units that collectively will provide the desired number of AUMs of grazing while, at the same time meeting the environmental constraints. This means that a "mix of strategies" results, depending upon production capability and costs.

New Factors in Resource Allocation

The public now, more and more, is demanding to share in the allocation of land for uses other than grazing. This is particularly true on public lands. It wants its forests to continue producing wood and good water. It wants shares of the resource not only for big game but for wild horses, rare and endangered species of wildlife, and songbirds. It wants some esthetic standards built in--elements of solitude, natural beauty and heritage preservation. It wants some of the lands for recreation. All of these considerations have added new dimensions to what before would have been a fairly simple formula to determine what is enough forage to feed the livestock needed, in turn, to feed the Nation.

But that simple formula will no longer do. The demands for other products and values have grown rapidly in the last few years and are expected to increase even more rapidly in the years ahead. They will be constraints on any management actions to manipulate or modify rangelands for production of livestock forage.

The Forest-Range Environmental Study was an attempt to weigh all demands upon the Nation's wildland environment against its capability to produce grazing in an efficient manner, while at the same time enhancing environmental quality.

FRES Publications

Detailed descriptions of the study and the systems of appraisal which grew out of it are described in four publications. They are:

The Nation's Range Resources--A Forest-Range Environmental Study. This is the basic publication, describing the concepts and methods, information on supply and demand for resources from the forest-range and analyses of alternative mixtures of resource uses. Forest Resource Report No. 19. (Available)

Forest-Range Environmental Production Analytical System (FREPAS). This is the description of the analytical and computer capability developed for FRES. Agriculture Handbook 430. (Available)

Vegetation and Environmental Features of Forest and Range Ecosystems. This describes the system of classifying forest-range land in the 48 contiguous States into 34 units, called "ecosystems." It discusses vegetation, soils, fauna, and other identifying features of each. (Number not yet assigned; available summer, 1973).

Range Management Practices: Investment Costs, 1970. This reports on the 18 range management practices examined in FRES. It lists investment costs for each practice in each of 956 resource units within the 34 major ecosystems. Agriculture Handbook No. 435. (Available)

Questions and Answers

Q. What effect would complete acceptance of one of the least-cost alternatives for Federal grazing programs have on price of beef in the future?

A. Very little, if any. Beef prices are a function of supply-demand relationships that are associated with income levels, consumer tastes, and many other factors. All sources of livestock feed energy play a part.

Benefits of the least-cost alternatives lie in better land use, enhancement of the environment, and greater efficiency in range programs. The increased amount of forest-range grazing on the Federal lands at higher National levels of demand would not increase the supply of beef enough to affect prices. In 1970, only three percent of the forage requirement of all the beef cows in the Nation was provided by the Federal lands.

Q. Simply stated, what is it the Forest Service is trying to accomplish with such a complicated study?

A. The Forest Service is trying to determine what share of the range the National Forest System should provide so it can keep its policies for range management and development abreast of needs. Since livestock grazing has to fit into the use of other resources, the agency also needs to know how grazing affects wood growth, recreation, wildlife habitat, watershed, and the like. An important related need is to assure that monies available for Federal programs are efficiently spent.

This study assembled the necessary information about the need for livestock grazing, costs of production, and impacts of livestock grazing necessary for setting new national direction for managing National Forest System ranges. Because these Federal lands are so interrelated with lands of other ownerships, it was necessary to assemble information about them also and use it in establishing goals for Forest Service range livestock grazing.

An important related need was to find out the status and need for livestock grazing on non-Federal forest-range, for which the Forest Service shares a cooperative responsibility with the Federal and State agencies.

Since it is necessary to assure that forest-range policies are the best within the limitations of national need, resource availability and cost, many alternative courses of action have to be explored. To meet this need, the Study developed a computer-based system (FREPAS) which permits the agency to predict the costs of environmental consequences of many different alternatives. From these alternatives, the Forest Service can develop programs which best satisfy the agency's objectives.

Q. Is grazing on Federal lands really needed? Can non-Federal range and pasture provide sufficient forage to meet demand for meat without use of Federal range?

A. Yes to both questions. Non-Federal ranges and pastures could provide enough forage without Federal grazing. Only about 3 percent of the forage required to support all of the Nation's beef cows comes from the Federal lands. The non-Federal lands have enough untapped potential to yield forage to absorb this 3 percent. However, it is highly improbable that need for Federal forage will disappear.

Portions of the Federal range are economically competitive with non-Federal lands in forage production. So long as this is the case, need for this grazing will continue. Additionally, location of the Federal grazing is an important factor suggesting strong need for its continued availability. Throughout the Western United States, thousands of ranches depend upon the adjacent Federal lands for livestock grazing. Without the Federal grazing, many of these ranchers could not produce enough forage to sustain their herds year-long. Many ranchers would have to reduce their numbers of livestock or go out of business without the Federal grazing. This would lead to serious local and regional social and economic effects.

Q. More specifically, what types of lands were included and what surface areas of the 48 States were excluded from the study area?

A. The inventory of forest-range covered all lands in the 48 States in native and natural grasslands and commercial and non-commercial forest lands. It also included desert areas and barren areas above treeline. All of the land in the Study amounted to 1.2 billion acres.

Not included were urban lands, transportation system lands, improved pasture, croplands and major waterways, the remaining 0.7 billion acres in the 48 States.

Q. The study determined that existing policy and management direction would produce more range grazing than needed by year 2000. Won't this policy and management direction be self-adjusting as forage supply begins significantly exceeding demand?

A. Yes. Both policy and management direction would self-adjust and come more in line with supply-demand relationships. However, a self-adjustment process would waste money and effort that could be used for other purposes. FRES suggests it is far better to anticipate trends so requirements can be met in an efficient, systematic manner.

Q. Can the FRES analytical system be applied to other Forest Service or other ownership planning programs?

A. Yes, the system can be applied to many other planning programs. Concepts included in this system are now used in a variety of planning programs, for example, the Comprehensive River Basin Studies sponsored by the National Water Resource Council. This (FRES) system was developed for the specific purpose of range program and policy analysis for a Federal land resource management agency. It can be applied to other Forest Service programs or those of other Federal agencies by development of the proper data and specific provisions for the program to be analyzed.

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